

REMARKS

The amendment to claims 1, 20 and 24 is supported by claim 5. Claims 11-13 have been cancelled. Claims 1-3, 5-10, 18-22, 24, 28, 30, 31 and 38-42 are present and active in the application.

C/C composites are considerably stronger and lighter than steel. Such materials increase in strength with increasing heat treatment and resist thermal shock caused by rapid temperature change. However, they suffer from a number of drawbacks including poor oxidation resistance, highly variable wear rates and coefficient of friction, and costly manufacturing. Carbon fibers reinforcing a boron nitride matrix (C/BN composites) have the potential to overcome some of the shortcomings of C/C (Pat. No. 5,399,377), but do not have acceptable heat capacity and thermal conductivity to substitute for C/C composites in aircraft brakes, due to low density. The present invention mitigates this problem.

The present invention is directed to methods for manufacturing high density boron nitride composite materials, including: forming a mixture comprising borazine oligomer, and subjecting the mixture to a first heating. As now claimed, the first heating is at 60 °C to 80 °C, and at a pressure of at least 1 MPa.

The rejections of the claims under 35 U.S.C. 103 over U.S. Patent No. 5,399,377 (Economy '337) in view of Spain et al. and in further view of U.S. Patent No. 4,075,276 (Economy '276), optionally in combination with Lavasserie et al., and/or Parlier et al., are respectfully traversed. Spain et al. apply a slight pressure, e.g. 100 psi or less, to the mold to keep it closed, and specifically wish to limit the pressure applied to the preform.

Economy '337 describes borazine oligomer and boron nitride composite materials. Borazine oligomer is prepared by heating borazine at 70 °C (col. 3, lines 13-15). The preparation of the composites is only described in the examples: the oligomeric precursor is impregnated into a fiber bundle, and then the matrix is partially stabilized in shape through further polymerization in the temperature range of 50 °C to 90 °C for two days under a nitrogen atmosphere in an oven (col. 4, lines 24-35). Next, thermal processing is conducted under non-oxidative cross-linking conditions to a final temperature of 400 °C supplied by a Carver hot-press, with molding pressures gradually

applied up to 5 ksi (col. 4, lines 38-45). There is no suggestion to apply pressure during the first heating at 50 °C to 90 °C – this heating is carried out in an oven under a nitrogen atmosphere.

Spain et al. describes composite preforms. In the process of making the composite preforms, a preform is impregnated with a resin solution, and then the impregnated preform is placed in a shaping fixture or shaping mold, and solvent is removed under vacuum (col. 4, lines 24-40). The mold containing the impregnated preform is transferred to a heated press, and heat and pressure are applied to cure and pre-rigidize the resin (col. 4, lines 41-45). The pressure applied is to the mold itself, and is only enough to close the mold; Spain et al. specifically wish to limit the pressure applied to the preform:

Typically, only a slight pressure is applied to the mold; e.g., to effect closure of the mold halves together or partial closure as permitted by mold closure control stops (e.g., 100 psi or less). The mold may include the mold closure stops to limit the degree of pressure applied to the preform.

(col.4, lines 45-50). Since only a slight pressure is applied to the mold for the purpose of closing the mold, and mold closure stops may be used to limit the degree of pressure applied to the preform, there is no suggestion to increase the pressure on the preform itself beyond 100 psi (about 0.6 MPa).

Economy '276 has been cited for the proposition that higher pressures yield higher density products. Lavasserie et al. and Parlier et al. have been cited for elements of dependent claims.

As claimed, the present invention specifies a temperature of the first heating of 60 °C to 80 °C, and a pressure of at least 1 MPa. Spain et al. applies a slight pressure to the mold, rather than the preform, to close the mold; Spain et al. specifically wish to limit the pressure on the preform. Since the pressure applied to the mold by Spain et al. is slight (about 0.6 MPa or less), and is for the purpose of closing the mold, there would be no reason to increase the pressure on the preform itself beyond 0.6 MPa. The remaining references fail to suggest applying pressure the mixture during the first heating. Accordingly, applicants submit that the claimed invention is not obvious over

the applied references. Withdrawal of these grounds of rejection is respectfully requested.

Applicants submit that the present application is now in condition for allowance. Early notice of such action is earnestly solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Paul E. Rauch', is written over a horizontal line.

Paul E. Rauch, Ph.D.
Registration No. 38,591

Evan Law Group LLC
600 W. Jackson Blvd.
Suite 625
Chicago, Illinois 60661
(312) 876-1400